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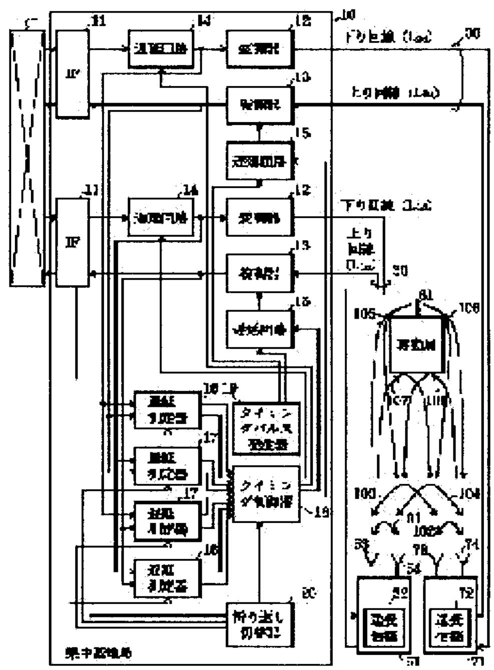
(54) MOBILE COMMUNICATION EQUIPMENT



(57)Abstract:
PROBLEM TO BE SOLVED: To obtain the bit synchronization of a mobile station for communicating with a different radio base station by measuring transmission/reception delay time in a plurality of routes while transmission is performed from a centralized base station and reception is performed through a plurality of radio base stations and the mobile station further.
SOLUTION: Signals modulated in the modulator 12 of the centralized base station 10 are transmitted through an outgoing channel to the radio base station 51, converted to a radio frequency and transmitted from an antenna 53. Simultaneously, they are received in the antenna 54, converted to a sub carrier frequency, transmitted through an incoming channel to the centralized base station 10 and demodulated in a demodulator 13. During the time, by detecting a unique word, delay time from the transmission to the reception is measured. Similarly, the delay time of the radio base station 72 is measured. Further, by a similar means, the transmission is performed from the centralized base station 10 to the radio base station 51, the reception is performed through the radio base station 71 by the centralized base station 10 and further, the transmission/reception delay time through the mobile station 81 is measured. Thus, the bit synchronization of the mobile station for performing the communication with the different radio base station is performed.

* NOTICES *

3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]

[Claim 1]Two or more base transceiver stations which communicate by radio between mobile stations, comprising, Distribution and two or more of these base transceiver stations of a sending signal to two or more of these base transceiver stations are provided with a concentration base station which collects signals received, respectively, and it said concentration base station, A delay measuring means which measures transmission line delay between each of two or more of said base transceiver stations, Timing of a signal sent out to said two or more base transceiver stations according to measured value of this delay measuring means, respectively including a timing adjustment means to adjust said delay measuring means, The first measuring means that measures transfer time until a signal sent out from said concentration base station is transmitted from the base transceiver station to each of two or more of said base transceiver stations, it is directly received by the same base transceiver station and it returns to said concentration base station, A moving communication device including the second measuring means that measures transfer time until a signal sent out from said concentration base station is transmitted from the base transceiver station, it is received by other base transceiver stations and it returns to said concentration base station.
Said delay measuring means receives each of two or more of said base transceiver stations further, The third measuring means that measures transfer time until a signal sent out from said concentration base station is transmitted from the base transceiver station, it is received by mobile station, a signal which the mobile station transmitted is received by the same base transceiver station and it returns to said concentration base station.
The fourth measuring means that measures transfer time until a signal sent out from said concentration base station is transmitted from the base transceiver station, it is received by mobile station, a signal which the mobile station transmitted is received by other base transceiver stations and it returns to said concentration base station.

[Claim 2]The moving communication device according to claim 1 provided with a means which is constituted by delay measuring instrument with common said first measuring means and said third measuring means, and changes operation of this common delay measuring instrument.
[Claim 3]The moving communication device according to claim 1 or 2 provided with a means which is constituted by delay measuring instrument with common said second measuring means and said fourth measuring means, and changes operation of this common delay measuring instrument.
[Claim 4]The moving communication device according to claim 1 with which said timing adjustment means contains a means to adjust timing so that data may reach two or more mobile stations to the same timing substantially.
[Claim 5]The moving communication device according to claim 1 containing a means to which the bit synchronization of the data which said timing adjustment means transmits to one mobile station from two or more base transceiver stations is carried out with the mobile station.
[Claim 6]Two or more demodulators which restore to a signal which two or more modulator and said two or more base transceiver stations which modulate a signal which said two or more base transceiver stations transmit, respectively received, respectively are formed in said concentration base station, The moving communication device according to claim 1 containing a means to adjust operation timing of said demodulator to said concentration base station according to measured value of said delay measuring means.
[Claim 7]The moving communication device according to claim 1 with which a demodulator which restores to a signal received from a modulator and a mobile station which modulate a signal transmitted to a mobile station was formed in each of two or more of said base transceiver stations.

[Translation done.]

* NOTICES *

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the moving communication device which used the TDMA-TDD (Time Division Multiple Access-Time DivisionDuplex) method. Even if it is a case where the delay adjustment during the transmission and reception in the case of performing a burst strange recovery especially differs from the base transceiver station where a mobile station communicates, it is related with the art of performing the timing synchronization of the frame of a burst which a mobile station receives.
[0002]
[Description of the Prior Art]In a TDMA-TDD system, a burst modulating signal performs bidirectional communication at time sharing using the same radio carrier. When the method of carrying out concentrated control of the base transceiver station is adopted, it is transmitted to a base transceiver station via a transmission line, it is transmitted from the antenna of a base transceiver station, and the burst modulating signal which carried out burst abnormal conditions in the concentration base station is received by the mobile station. It is received by the antenna of a base transceiver station, the burst modulating signal which the mobile station transmitted is inputted into the demodulator of a concentration base station via a transmission line, and it restores to it to received data. In a burst strange recovery, an abnormal-conditions burst position is detected by detecting a unique word pattern out of the received data. Since there is a possibility that the receiving pattern same besides true unique word as unique word may exist, and a timing position cannot be judged correctly when coincidence comparison detection of received data and the unique word pattern is always carried out, It is necessary to install a unique-word-detection window, to perform coincidence comparison detection only by a detection window, and to improve an erroneous detection rate. The delaying amount from the transmission burst of this detection window is set up by the timing during transmission and reception. The position of a unique-word-detection window must be controlled by concentrated control using a transmission line with a timing-control machine. The time required of transmission-line transfer can be measured by comparing the position of the unique word of a transmission burst with the position of the unique word of a receiving burst.
[0003]In a TDMA-TDD system, the timing synchronization of the burst which transmits among two or more base transceiver stations is taken, and a transmission burst phase is arranged by a frame synchronization. If it transmits from a base transceiver station to the timing which was overdue for transmission line delay, the unique word from a base transceiver station is not applied to the position of the unique-word-detection window of a mobile station. Therefore, it cannot restore to burst modulation data and a synchronization cannot be taken. In order to avoid this, transmission-line-delay time is expected and it gets down rather than the burst position which transmits from a base transceiver station, and it is necessary to transmit a priori, and only

for transmission-line-delay time to delay only uphill transmission-line-delay time, and to receive it in a concentration base station.

[0004]Drawing 5 is a block lineblock diagram showing the moving communication device of a conventional example. This moving communication device is provided with the concentration base station 10 where it was connected to the public network 1, and intensive arrangement of the modulator and demodulator was carried out, and the base transceiver stations 51 and 71 which communicate between mobile stations by being connected to this concentration base station 10 via the transmission line 30, and transmitting and receiving an electric wave from an antenna. The interface circuit 11 where the concentration base station 10 performs signal transformation between the public networks 1, The modulator 12 which modulates the data transmitted to the base transceiver stations 51 and 71, and the demodulator 13 which restores to the data from the base transceiver stations 51 and 71, The delay circuit 14 which sets the delaying amount of send data as variable, and the delay circuit 15 which sets the delaying amount of received data as variable, The delay measuring instruments 21 and 22 which compare the data transmitted from the concentration base station 10 with the data received in the concentration base station 10, and measure the time required of transmission-line passage, It has the timing-control machine 18 which computes the amount of timing adjustments of transmission and reception with the measured value of these delay measuring instruments 21 and 22, and the timing generator 19 which generates the reference timing for performing timing adjustment. The base transceiver station 51 shall be provided with the transmitter-receiver 52 which changes a radio signal into a radio frequency, and is transmitted and received, and the two antennas 53 and 54, one antenna 53 or 54 shall perform transmission, both antennas 53 and 54 shall perform reception, and the one where a receiving level is higher shall be chosen. The base transceiver station 71 is similarly provided with the transmitter-receiver 72 and the two antennas 73 and 74.

[0005]As a course which returns to the concentration base station 10, the data transmitted from the concentration base station 10, It adds to the transmission line 30, The space propagation paths 101 and 102 which get down, transmit the signal from a circuit from each one antenna 53 of the base transceiver stations 51 and 71, or 54, 73 or 74 between non-railroad sections, and are received by the antenna 54 of each another side of the same base transceiver stations 51 and 71, or 53, 74 or 73, There are the space propagation paths 103 and 104 which get down, transmit the signal from a circuit from each antenna 53 of the base transceiver stations 51 and 71, or 54, 73 or 74 between non-railroad sections, and are received by each antenna 73 of another base transceiver stations 71 and 51, 74 and 53, or 54. Usually, since it is very short compared with the distance between base transceiver stations, the distance between antennas does not need to take into consideration the propagation delay time by the space propagation paths 101 and 102. Below, space propagation delay time by the space propagation paths 103 and 104 is made into A_{12}.

[0006]The timing to which the delay measuring instrument 21 transmitted data from the concentration base station 10, The timing which transmitted the signal from the base transceiver stations 51 and 71, and received this via the same base transceiver stations 51 and 71 in the concentration base station 10 is compared, and the time required of a round trip of a transmission line when it goes via the space propagation paths 101 and 102, respectively is measured. The timing to which the delay measuring instrument 22 transmitted data from the concentration base station 10 on the other hand, The timing which received in the concentration base station 10 via the base transceiver stations 71 and 51 which transmit a signal from the base transceiver stations 51 and 71, and are different in this is compared, and the both-way time required of a transmission line when it goes via the space propagation paths 103 and 104, respectively is measured. Based on the measured value of the delay measuring instruments 21 and 22, the timing-control machine 18 gets down, calculates the transmit timing of a circuit, and the receiving timing of an upstream, and adjusts sending and receiving timing with the delay circuits 14 and 15. Thereby, in the transmission line 30 between the concentration base station 10 and two or more base transceiver stations 51 and 71, when an up-and-down circuit has a transmission-line time lag for every [the base transceiver station 51 and] 71, a bit

synchronization can be established between the base transceiver stations 51 and 71.
[0007]
[Problem(s) to be Solved by the Invention]However, in the conventional moving communication device, when the space propagation delay time between a certain base transceiver station and mobile station differs from the space propagation delay time between other base transceiver stations and a mobile station. The frame synchronization phase between mobile stations cannot be doubled to two or more base transceiver stations which are communicating, When the tolerance level of the jitter of the data for every [in a mobile station or a base transceiver station] frame is small, the no hit handover which changes the connected base transceiver station to other base transceiver stations by no hit cannot be realized. The diversity between transmission cells which changes a base station and transmits is also unrealizable by transmitting the data received in two or more base transceiver stations to a concentration base station according to a transmission line, and judging those data.
[0008]Generally, in order that a mobile station may perform communication from arbitrary positions, the space propagation delay time cannot carry out specific, and is not equal. [of travelling period A_1 between a certain base transceiver station and mobile station and travelling period A_2 between other base transceiver stations and a mobile station] Travelling period A_1 and A_2 change every moment by moving, while a mobile station communicates. For this reason, the bit synchronization of the data transmitted from two or more base transceiver stations in a mobile station could not be taken, and the diversity change between transmission cells which changes send data to the distant base transceiver station of two games, and transmits to a mobile station was not completed.
[0009]This invention solves such a technical problem and an object of this invention is to provide the moving communication device which can establish the synchronization of a bit between the mobile stations with which the base transceiver stations which communicate differ, when random in a transmission line and a propagation path time delay in communication between a concentration base station and two or more mobile stations.
[0010]
[Means for Solving the Problem]Two or more base transceiver stations with which, as for this invention, a moving communication device of this invention communicates by radio between mobile stations, Distribution and two or more of these base transceiver stations of a sending signal to two or more of these base transceiver stations are provided with a concentration base station which collects signals received, respectively, and it a concentration base station, A delay measuring means which measures transmission line delay between each base transceiver station, and a timing adjustment means which adjusts timing of a signal sent out to each base transceiver station according to measured value of this delay measuring means are included, The first measuring means that measures transfer time until a signal sent out from a concentration base station is transmitted from the base transceiver station to each base transceiver station, a delay measuring means is directly received by the same base transceiver station and it returns to a concentration base station, A moving communication device including the second measuring means that measures transfer time until a signal sent out from a concentration base station is transmitted from the base transceiver station, it is received by other base transceiver stations and it returns to a concentration base station is characterized by comprising:
The third measuring means that measures transfer time until a signal sent out from a concentration base station is further transmitted from the base transceiver station to each base transceiver station, a delay measuring means is received by mobile station, a signal which the mobile station transmitted is received by the same base transceiver station and it returns to a concentration base station.
The fourth measuring means that measures transfer time until a signal sent out from a concentration base station is transmitted from the base transceiver station, it is received by mobile station, a signal which the mobile station transmitted is received by other base transceiver stations and it returns to a concentration base station.

[0011]Namely, in this invention, turn up data in a base transceiver station, without passing ** mobile station, compare the send data and received data, and a time delay during transmission and reception of a transmission line is measured, ** Measure a time delay as compared with received data which received send data of a base transceiver station in other base transceiver stations without passing a mobile station and to which it restored through a transmission line in a concentration base station, ** Measure a time delay during transmission and reception of a transmission line for send data and received data of a base transceiver station as compared with the time of communication with a mobile station, and measure a time delay as compared with received data which received send data of a base transceiver station in other base transceiver stations at the time of communication with ** mobile station and to which it restored through a transmission line in a concentration base station. And transmit timing variation time of a part which got down and includes both transmission-line-delay time of a circuit, and a space travelling period with these measured value, Receiving timing variation time of a part including both transmission-line-delay time of an upstream and a space travelling period is found by calculation, and transmit timing and receiving timing are adjusted according to this calculation result. A synchronization between several mobile stations with which base transceiver stations which are communicating differ by this is established, and reception in a concentration base station is enabled. Below, it is called "clinch" to receive data via a mobile station like ** and **, and to transmit to a concentration base station.

[0012]The first measuring means and third measuring means are constituted by common delay measuring instrument, and can be provided with a means which changes operation of this common delay measuring instrument. It is similarly constituted by a common delay measuring instrument about the second measuring means and fourth measuring means, and can have a means which changes operation of this common delay measuring instrument.

[0013]The timing adjustment means can contain a means to adjust timing so that data may reach two or more mobile stations to the same timing substantially, or a means to which the bit synchronization of the data transmitted to one mobile station from two or more base transceiver stations is carried out with the mobile station.

[0014]Two or more demodulators which restore to a signal which two or more modulator and each base transceiver station which modulate a signal which each base transceiver station transmits, respectively received, respectively can be formed in a concentration base station, and this concentration base station can be equipped with a means to adjust operation timing of a demodulator according to measured value of a delay measuring means. A modulator and a demodulator may provide in each of a base transceiver station.

[0015]According to this invention, time delay measurement including space propagation delay time is attained, and the mobile station can establish a bit synchronization between mobile stations which are carrying out communication with a different base transceiver station in arbitrary positions which can communicate. That is, the mobile station can take a synchronization of timing of a burst which a mobile station receives among base transceiver stations other than a base transceiver station where a local station is communicating. For this reason, even if a tolerable jitter of data for every frame which a mobile station and a base transceiver station receive is when very small in a state while a mobile station is talking over the telephone compared with transmission-line-delay time or propagation delay time, A no hit handover which is not based on a space travelling period between a base transceiver station and a mobile station, but changes a connected base transceiver station to other base transceiver stations by no hit is realizable. Diversity between transmission cells which changes a base transceiver station and transmits becomes possible by transmitting data received in two or more base transceiver stations to a concentration base station according to a transmission line, and judging it.

[0016]

[Embodiment of the Invention]Drawing 1 is a block lineblock diagram showing a first embodiment of this invention. This moving communication device is provided with the following.

Two or more base transceiver stations 51 and 71 which communicate by radio between the mobile stations 81 (here, one is shown).

The concentration base station 10 which collects the signals which distribution and two or more of these base transceiver stations 51 and 71 of the sending signal to two or more of these base transceiver stations 51 and 71 received, respectively.
The concentration base station 10 is provided with the following.
The interface circuitry 11 which performs transmission signal conversion between the modulator 12 and the demodulator 13, and the public network 1.
The modulator 12 which modulates the data transmitted to the base transceiver stations 51 and 71.
The demodulator 13 which restores to the data from the base transceiver stations 51 and 71.
The delay circuit 14 which sets the delaying amount of send data as variable, and the delay circuit 15 which sets the delaying amount of received data as variable, The delay measuring instruments 16 and 17 and the clinch switcher 20 which measure the transmission line delay between each of the base transceiver stations 51 and 71, The timing-control machine 18 which adjusts the timing of the signal sent out to the base transceiver stations 51 and 71 according to the measured value of the delay measuring instruments 16 and 17, respectively, and the timing pulse generator 19 which generates reference timing required in order to control the timing-control machine 18.
The base transceiver station 51 has composition which is provided with the transmitter-receiver 52 which changes a radio signal into a radio frequency, and is transmitted and received, and the two antennas 53 and 54, performs transmission with one antenna 53, performs reception with both antennas 53 and 54, and chooses the one where a receiving level is higher among the received wave. The base transceiver station 71 is similarly provided with the transmitter-receiver 72 and the antennas 73 and 74.
[0017]The delay measuring instruments 16 and 17 measure the time delay which is with the time of not carrying out with the time of the base transceiver stations 51 and 71 communicating with the mobile station 81, and changes with control of the clinch switcher 20.
[0018]Namely, the timing which sent out the signal from the concentration base station 10 to the base transceiver stations 51 and 71 when the delay measuring instrument 16 did not communicate with the mobile station 81, Send out a signal from the concentration base station 10 to the base transceiver stations 51 and 71, and it is transmitted by the antennas 53 and 73 of the base transceiver stations 51 and 71, The time required which transmission-line passage takes is measured by transmitting the signal received by the antennas 54 and 74 of another side of the office from the base transceiver stations 51 and 71 to the concentration base station 10, and comparing the timing which received the signal in the concentration base station 10. The timing sent out from the concentration base station 10 to the base transceiver stations 51 and 71 when the delay measuring instrument 16 communicated with the mobile station 81 again, Send out a signal from the concentration base station 10 to the base transceiver stations 51 and 71, it is transmitted to the mobile station 81 from the base transceiver stations 51 and 71, and the base transceiver stations 51 and 71 receive the signal from the mobile station 81 which answered, It is transmitted from the base transceiver stations 51 and 71 to the concentration base station 10, and the time required which transmission-line passage takes at the time of communication with the mobile station 81 is measured by comparing the timing which received the signal in the concentration base station 10.
[0019]The timing which sent out the signal from the concentration base station 10 to the base transceiver stations 51 and 71 on the other hand when the delay measuring instrument 17 did not communicate with the mobile station 81, Send out a signal from the concentration base station 10 to the base transceiver stations 51 and 71, and it is transmitted by the antennas 53 and 73 of the base transceiver stations 51 and 71, The time required which transmission-line passage takes is measured by transmitting the signal received by the antenna 73 of other base transceiver stations 71 and 51, or 74, 53 or 54 from the base transceiver stations 71 and 51 to the concentration base station 10, and comparing the timing which received the signal in the concentration base station 10. The timing sent out from the concentration base station 10 to the base transceiver stations 51 and 71 when the delay measuring instrument 17 communicated with the mobile station 81 again, Send out a signal from the concentration base station 10 to the

base transceiver stations 51 and 71, and it is transmitted to the mobile station 81 from the base transceiver stations 51 and 71, and other base transceiver stations 71 and 51 receive the signal from the mobile station 81 which answered, It is transmitted from the base transceiver stations 71 and 51 to the concentration base station 10, and the time required which transmission-line passage takes at the time of communication with the mobile station 81 is measured by comparing the timing which received the signal in the concentration base station 10.

[0020]Each measurement result of the delay measuring instruments 16 and 17 is inputted into the timing-control machine 18. From these measurement results, the timing-control machine 18 computes the amount of timing adjustments of transmission and reception, and sets up the delaying amount of the delay circuits 14 and 15. The delay circuit 14 sets the delaying amount of the data transmitted from the base transceiver stations 51 and 71 as variable using the information from the timing-control machine 18. The delay circuit 15 sets the timing which can receive the data in the base transceiver stations 51 and 71 as variable using the information from the timing-control machine 18. Reference timing required in order to control the timing-control machine 18 is generated by the timing pulse generator 19. Operation of the delay measuring instruments 16 and 17 is changed by the clinch switcher 20.

[0021]Measurement of transmission-line-delay time and space propagation delay time is explained in more detail. Here, L_{1d} and transmission-line transfer time of an upstream are made into L_{1u} for the transmission-line transfer time of the going-down circuit in the transmission line 30 between the concentration base station 10 and the base transceiver station 51. L_{2d} and transmission-line transfer time of an upstream are made into L_{2u} for the transmission-line transfer time of the going-down circuit in the transmission line 30 between the concentration base station 10 and the base transceiver station 71.

[0022]First, transmission-line-delay time measurement when not telephoning to a mobile station, and measurement of space propagation delay time are explained.

[0023]In this case, transfer time L_{1d} gets down and the signal modulated with the modulator 12 of the concentration base station 10 is transmitted to the base transceiver station 51 via a circuit, It changes into a radio frequency in the base transceiver station 51, and it transmits from the antenna 53 of the base transceiver station 51, the antenna 54 of the base transceiver station 51 receives, and it changes into subcarrier frequency, transmits to the concentration base station 10 via the upstream of transfer time L_{1u}, and gets over with the demodulator 13. At this time, time after transmitting after abnormal conditions until it receives and gets over is measured as a time delay by detecting unique word in the concentration base station 10. Thereby, the transfer time of $L_{1d}+L_{1u}$ is measured. This time is made into T_{11}. It measures similarly about the base transceiver station 71, and the transfer time of $L_{2d}+L_{2u}$ is measured. This time is made into T_{22}.

[0024]Transfer time L_{1d} gets down and the signal modulated with the modulator 12 of the concentration base station 10 is transmitted to the base transceiver station 51 via a circuit, Change into a radio frequency in the base transceiver station 51, and it transmits from the antenna 53 of the base transceiver station 51, The antenna 73 or 74 of the base transceiver station 71 receives via the propagation path of space travelling period A_{12}, and it transmits to the concentration base station 10 via the upstream of transfer time L_{2u}, and gets over with the demodulator 13. At this time, time after transmitting after abnormal conditions until it receives and gets over is measured as a time delay by detecting unique word before and after transmission and reception in the concentration base station 10. Thereby, the transfer time of $L_{1d}+A_{12}+L_{2u}$ is measured. This time is made into T_{12}. It measures similarly about the case where it transmits from the base transceiver station 71, and the base transceiver station 51 receives, and the transfer time of $L_{2d}+A_{12}+L_{1u}$ is measured. This time is made into T_{21}.

[0025]A transmission-line-delay time lag is searched for from these measurement results. It is

$L_{1d}+L_{1u}=T_{11}$ when a formula shows the above-mentioned conditions. -- (1)

$L_{2d}+L_{2u}=T_{22}$ -- (2)

$L_{1d}+L_{2u}+A_{12}=T_{12}$ -- (3)

$L_{2d}+L_{1u}+A_{12}=T_{21}$ -- (4)

It becomes. (3) From +(4)-(1)-(2), it is $2A_{12}=T_{12}+T_{21}-T_{11}-T_{22}$. -- (5)

$A_{12}=(T_{12}+T_{21}-T_{11}-T_{22})/2$ -- (6)

It becomes. It is $T_{11}-T_{12}=(L_{1u}-L_{2u})-A_{12}$ from (1)-(3). -- (7)

$L_{1u}-L_{2u}=T_{11}-T_{12}+A_{12}$-- (8)

From (2)-(4), it is $T_{11}-T_{21}=(L_{1d}-L_{2d})-A_{12}$. -- (9)

$L_{1d}-L_{2d}=T_{11}-T_{12}+A_{12}$ -- (10)

It becomes. (8) From a formula, transfer time difference $L_{1u}-L_{2u}$ of the upstream from the base transceiver station 51 to the concentration base station 10 and the upstream from the base transceiver station 71 to a concentration base station is calculated. It gets down from the going-down circuit and the concentration base station 10 from the concentration base station 10 to the base transceiver station 51 to the base transceiver station 71 by (10) types, and transfer time difference $L_{1d}-L_{2d}$ with a circuit is calculated.

[0026]Next, transmission-line-delay time measurement when telephoning to the mobile station 81, and measurement of space propagation delay time are explained. Here, the mobile station 81 assumes that it is communicating via the base transceiver station 51 first.

[0027]Transfer time L_{1d} gets down and the signal modulated with the modulator 12 of the concentration base station 10 is transmitted to the base transceiver station 51 via a circuit, Change into a radio frequency in the base transceiver station 51, and it transmits from the antenna 53 of the base transceiver station 51, It is received by the antenna of the mobile station 81 via the propagation path of space travelling period A_1, The data from the mobile station 81 which answered this is transmitted from the antenna of the mobile station 81, the antennas 53 and 54 of the base transceiver station 51 receive via the propagation path of space travelling period A_1, and it transmits to the concentration base station 10 via the upstream of transfer time L_{1u}, and gets over with the demodulator 13. At this time, time after transmitting after abnormal conditions until it receives and gets over is measured as a time delay by detecting unique word in the concentration base station 10. Thereby, the transfer time of $L_{1d}+A_1+A_1+L_{1u}$ is measured. This time is made into T_{1a1}.

[0028]Transfer time L_{1d} gets down and the signal modulated with the modulator 12 of the concentration base station 10 is transmitted to the base transceiver station 51 via a circuit, Change into a radio frequency in the base transceiver station 51, and it transmits from the antenna 53 of the base transceiver station 51, It is received by the antenna of the mobile station 81 via the propagation path of space travelling period A_1, Transmit the data from the mobile station 81 which answered this from the antenna of the mobile station 81, the antennas 73 and 74 of the base transceiver station 71 receive via the propagation path of space travelling period A_2, and it changes into subcarrier frequency in the base transceiver station 71, It transmits to the concentration base station 10 via the upstream of transfer time L_{2u}, and gets over with the demodulator 13. At this time, time after transmitting after abnormal conditions until it receives and gets over is measured as a time delay by detecting unique word in the concentration base station 10. Thereby, the transfer time of $L_{1d}+A_1+A_2+L_{2u}$ is measured. This time is made into T_{1a2}.

[0029]A transmission-line-delay time lag is searched for from these measurement results. It is $L_{1d}+A_1+A_1+L_{1u}=T_{1a1}$ when a formula shows the above-mentioned conditions. -- (11)

$L_{1d}+A_1+A_2+L_{2u}=T_{1a2}$ -- (12)
It becomes. Next, when transmit timing variation time needed is set to delay1 and receiving timing variation time is set to delay2, it is delay1= $(L_{1d}+A_1)$. - $(L_{2d}+A_2)$ -- (13)
delay2= $(L_{1u}+A_1)-(L_{2u}+A_2)$ -- (14)
It is expressed. From (11)-(12), it is $(L_{1u}+A_1)-(L_{2u}+A_2)=T_{1a1}-T_{1a2}$. -- (15)
a next door, therefore delay2=$T_{1a1}-T_{1a2}$-- (16)
It can carry out and delay2 can be drawn. moreover -- transforming (15) types -- $(L_{1u}-L_{2u})+(A_1-A_2)=T_{1a1}-T_{1a2}$-- (17)
It carries out. From (17)-(18), it is $(T_{11}-T_{12}+A_{12})+(A_1-A_2)=T_{1a1}-T_{1a2}$. -- (18)
Since it comes out, it is = (A_1-A_2) $(T_{1a1}-T_{1a2})$. $-(T_{11}-T_{12}+A_{12})$-- (19)
It becomes. moreover -- transforming (13) types -- delay1=$(L_{1d}-L_{2d})-(A_1-A_2)$ -- (20)
Since it comes out, it is delay1= $(T_{11}-T_{12}+A_{12})$ from (19), (20), and (10) types. - $(T_{11}-T_{12}+A_{12})$ + $(T_{1a1}-T_{1a2})$ --- (21)
**********. (16) From a formula, transfer time difference $(L_{1u}+A_1)-(L_{2u}+A_2)$ with the upstream to a concentration base station is called for through the upstream and the base transceiver station 71 to the concentration base station 10 through the base transceiver station 51 from the mobile station 81. By (21) types, even the mobile station 81 gets down from the concentration base station 10 through the going-down circuit and the concentration base station 10 to the mobile station 81 to the base transceiver station 71 through the base transceiver station 51, and transfer time difference $(L_{1d}+A_1)-(L_{2d}+A_2)$ with a circuit is called for.

[0030]Thus, the bit synchronization of the mobile station which is communicating with a different base transceiver station is realizable using the transfer time difference searched for.

[0031]Drawing 2 is a figure explaining the timing adjustment for taking a synchronization, and drawing 3 is a figure explaining the timing of signal transduction. here -- **** -- L -- $_{1d}$ - L -- $_{2d}$ -- > -- zero -- L -- $_{1u}$ - L -- $_{2u}$ -- > -- zero -- (-- L -- $_{1d}$ -- + -- A -- $_1$ --) - $(L_{2d}+A_2)$ -- > -- zero -- (-- L -- $_{1u}$ -- + -- A -- $_1$ --) - $(L_{2u}+A_2)$ -- > -- zero -- assuming . The interval of the reference timing of the transmission and reception in a mobile station is set to Td. Expressing a base transceiver station with "1" and "2", a mobile station shall communicate via a base transceiver station "2" first among these base transceiver stations "1" and "2."

[0032]First, a signal is sent out to a base transceiver station "2" from a concentration base station, a signal is sent out between non-railroad sections from a base transceiver station "2", and time to return to the concentration base station where the signal was received by a base transceiver station "1" and "2" as it was is measured, respectively. Next, a signal is sent out to a base transceiver station "2" from a concentration base station, a signal is sent out between non-railroad sections from a base transceiver station "2", a mobile station receives, and time to be received by a base transceiver station "1" and "2", respectively, and for the signal which the mobile station answered and transmitted to this return to a concentration base station is measured, respectively. Thereby, it turns out that it is necessary bring only the time of delay1 forward and to transmit a signal to a base transceiver station "1" from the timing which gets down and transmits to a base transceiver station "2" as transmit timing in a concentration base station. It turns out that a signal arrives from a base transceiver station "1" as uphill receiving timing later than the timing sent from a base transceiver station "2" only in the time of delay2.

[0033]Therefore, after this, from the timing which transmits to a base transceiver station "2", a concentration base station brings only delay1 forward and transmits a signal to a base transceiver station "1." Thereby, with a mobile station, the time difference between the signal transmitted from the base transceiver station "1" and the signal transmitted from the base transceiver station "2" can be lost, the base transceiver station of a communications partner can be changed to "1" from "2", and communication can be continued. A concentration base station is that only delay2 delays again the receiving timing of the signal sent from a base

transceiver station "2" to the receiving timing of the signal with which it is sent from a base transceiver station "1", The receiving timing of the signal from two base transceiver stations "1" and "2" can be doubled, and it can receive.

[0034]Here $L_{1d}-L_{2d}$, $L_{1u}-L_{2u}$, Although the case where all $(L_{2u}+A_2)$ of $(L_{1d}+A_1)-(L_{2d}+A_2)$ and $(L_{1u}+A_1)-$ were positive was explained to the example, negative or the zero of these values are also the same.

[0035]Thus, when [including space propagation delay time] it gets down and only the travelling period difference of a circuit adjusts transmit timing, the bit synchronization in a mobile station becomes possible about the signal from two or more base transceiver stations. Reception becomes possible, without a burst lapping in a concentration base station because only the transmission delay time subtraction of an upstream including space propagation delay time adjusts receiving timing.

[0036]Drawing 4 is a block lineblock diagram showing a second embodiment of this invention. This moving communication device differs in the demodulator which restores to the signal received from the modulator and mobile station which modulate the signal transmitted to a mobile station having been formed in each base transceiver station from a first embodiment. Namely, two or more base transceiver stations 51 and 71 which communicate by radio between the mobile stations 81 (here, one is shown), Distribution and two or more of these base transceiver stations 51 and 71 of the sending signal to two or more of these base transceiver stations 51 and 71 are provided with the concentration base station 10 which collects the signals received, respectively, and the concentration base station 10 is provided with the following.

The interface circuit 11 which performs transmission signal conversion between the public networks 1.

The delay circuit 14 which sets the delaying amount of send data as variable.

The delay measuring instruments 16 and 17 and the clinch switcher 20 which measure the transmission line delay between each of the base transceiver stations 51 and 71.

The timing-control machine 18 and the timing pulse generator 19 which adjust the timing of the signal sent out to the base transceiver stations 51 and 71 according to the measured value of the delay measuring instruments 16 and 17, respectively.

The transmitter-receiver 52 which the base transceiver station 51 changes a radio signal into a radio frequency, and is transmitted and received, The modulator 55 which modulates the data from the concentration base station 10, and the demodulator 56 which restores to the signal received by radio, It has composition which is provided with the two antennas 53 and 54, performs transmission with one antenna 53, performs reception with both antennas 53 and 54, and chooses the one where a receiving level is higher among the received wave. The base transceiver station 71 is similarly provided with the transmitter-receiver 72, the antennas 73 and 74, the demodulator 75, and the modulator 76.

[0037]The timing which sent out the signal from the concentration base station 10 to the base transceiver stations 51 and 71 when the delay measuring instrument 16 did not communicate with the mobile station 81, Send out a signal from the concentration base station 10 to the base transceiver stations 51 and 71, become irregular with the modulators 55 and 76 of the base transceiver stations 51 and 71, and it is transmitted by the antennas 53 and 73, The time required which transmission-line passage takes is measured by transmitting the signal by which it was received with the antennas 54 and 74 of another side of the office and to which it restored with the demodulators 56 and 75 from the base transceiver stations 51 and 71 to the concentration base station 10, and comparing the timing which received the signal in the concentration base station 10. The timing sent out from the concentration base station 10 to the base transceiver stations 51 and 71 when the delay measuring instrument 16 communicated with the mobile station 81 again, Send out a signal from the concentration base station 10 to the base transceiver stations 51 and 71, it is transmitted to the mobile station 81 from the base transceiver stations 51 and 71, and the base transceiver stations 51 and 71 receive the signal from the mobile station 81 which answered, It is transmitted from the base transceiver stations

51 and 71 to the concentration base station 10, and the time required which transmission-line passage takes at the time of communication with the mobile station 81 is measured by comparing the timing which received the signal in the concentration base station 10.

[0038]The timing which sent out the signal from the concentration base station 10 to the base transceiver stations 51 and 71 on the other hand when the delay measuring instrument 17 did not communicate with the mobile station 81, Send out a signal from the concentration base station 10 to the base transceiver stations 51 and 71, and it is transmitted by the antennas 53 and 73 of the base transceiver stations 51 and 71, The time required which transmission-line passage takes is measured by transmitting the signal received by the antenna 73 of other base transceiver stations 71 and 51, or 74, 53 or 54 from the base transceiver stations 71 and 51 to the concentration base station 10, and comparing the timing which received the signal in the concentration base station 10. The timing sent out from the concentration base station 10 to the base transceiver stations 51 and 71 when the delay measuring instrument 17 communicated with the mobile station 81 again, Send out a signal from the concentration base station 10 to the base transceiver stations 51 and 71, and it is transmitted to the mobile station 81 from the base transceiver stations 51 and 71, and other base transceiver stations 71 and 51 receive the signal from the mobile station 81 which answered, It is transmitted from the base transceiver stations 71 and 51 to the concentration base station 10, and the time required which transmission-line passage takes at the time of communication with the mobile station 81 is measured by comparing the timing which received the signal in the concentration base station 10.

[0039]Each measurement result of the delay measuring instruments 16 and 17 is inputted into the timing-control machine 18. From these measurement results, the timing-control machine 18 computes the amount of timing adjustments of transmission and reception, and sets up the delaying amount of the delay circuit 14. The delay circuit 14 sets the delaying amount of the data transmitted from the base transceiver stations 51 and 71 as variable using the information from the timing-control machine 18. Reference timing required in order to control the timing-control machine 18 is generated by the timing pulse generator 19. Operation of the delay measuring instruments 16 and 17 is changed by the clinch switcher 20.

[0040]According to this embodiment, what is necessary is to take into consideration only the data transmission timing to a modulator, and from the operation timing of a modulator, demodulator operation timing can be specified easily and does not need to take into consideration the amount of transmission line delay. Therefore, the delay circuit 15 used by a first embodiment is unnecessary. The method of transmission-line-delay measurement and timing adjustment is the same as that of a first embodiment.

[0041]

[Effect of the Invention]As explained above, according to this invention, even if it is a case where the transmission delay time by the transmission line between a concentration base station and a base transceiver station differs, and the space travelling distances between a base transceiver station and a mobile station differ, the synchronization between mobile stations is attained.

[Translation done.]

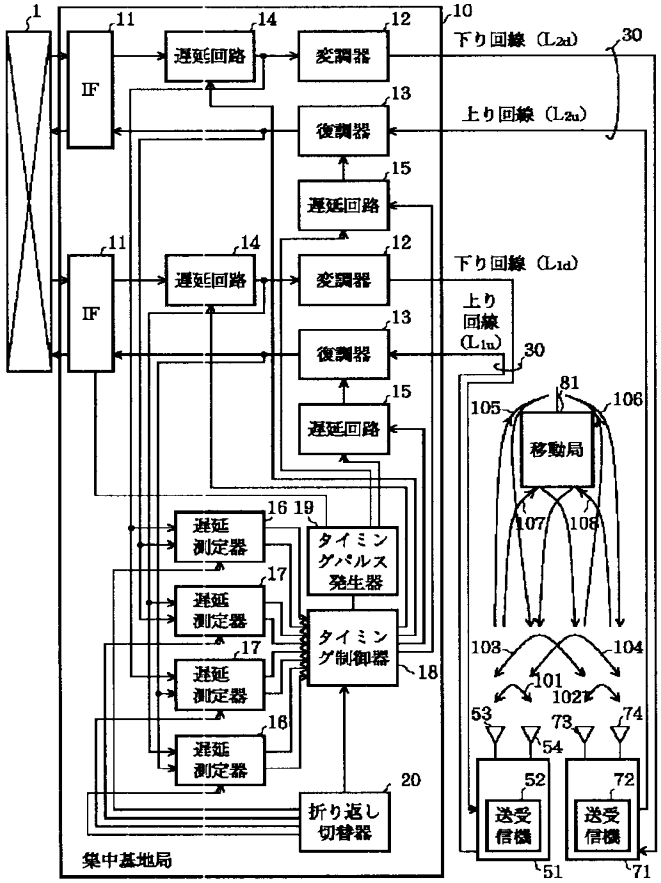
DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]The block lineblock diagram showing a first embodiment of this invention.
[Drawing 2]The figure explaining the timing adjustment for taking a synchronization.
[Drawing 3]The figure explaining the timing of signal transduction.
[Drawing 4]The block lineblock diagram showing a second embodiment of this invention.
[Drawing 5]The block lineblock diagram showing the moving communication device of a conventional example.
[Description of Notations]
1 Public network
10 Concentration base station
11 Interface circuit
12, 55, and 76 Modulator
13, 56, and 75 Demodulator
14 and 15 Delay circuit
16, 17, 21, and 22 Delay measuring instrument
18 Timing-control machine
19 Timing pulse generator
20 Clinch switcher
30 Transmission line
51 and 71 Base transceiver station
52 and 72 Transmitter-receiver
53, 54, 73, and 74 Antenna
81 Mobile station

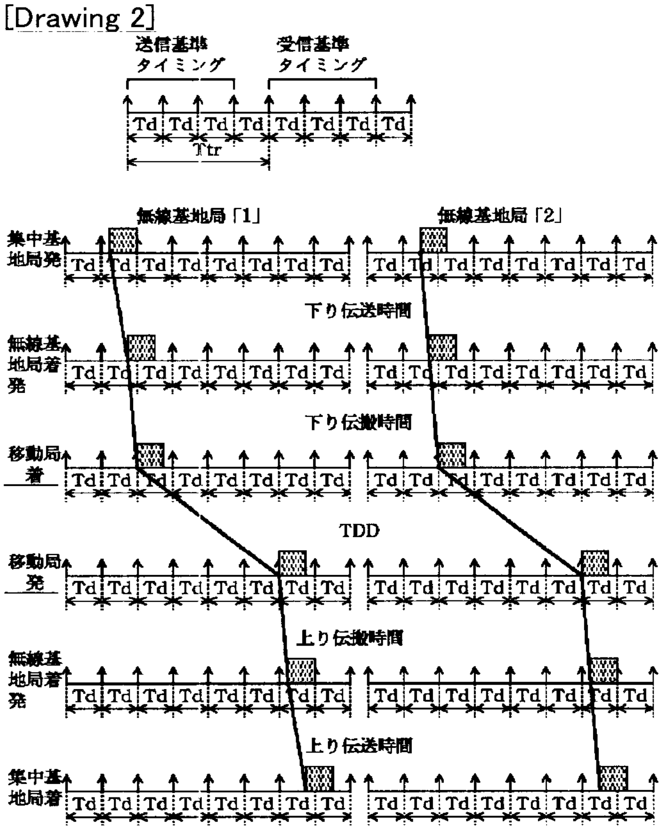
[Translation done.]

DRAWINGS

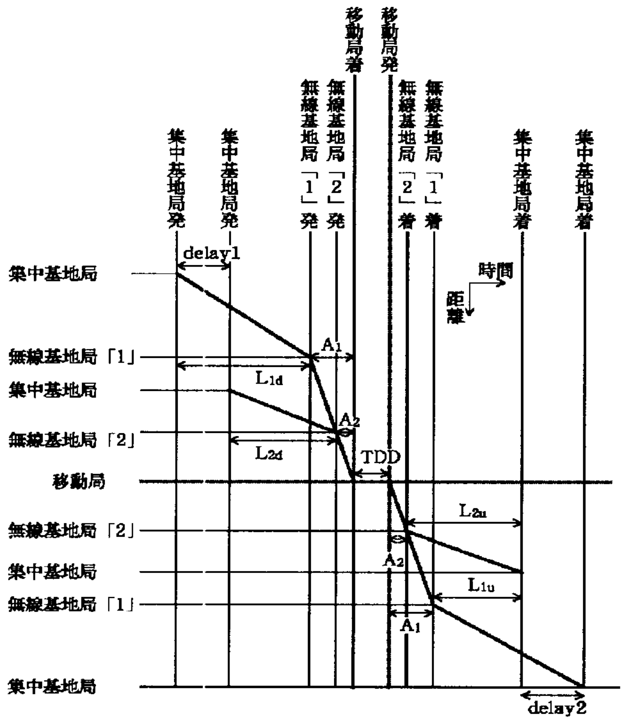
[Drawing 1]



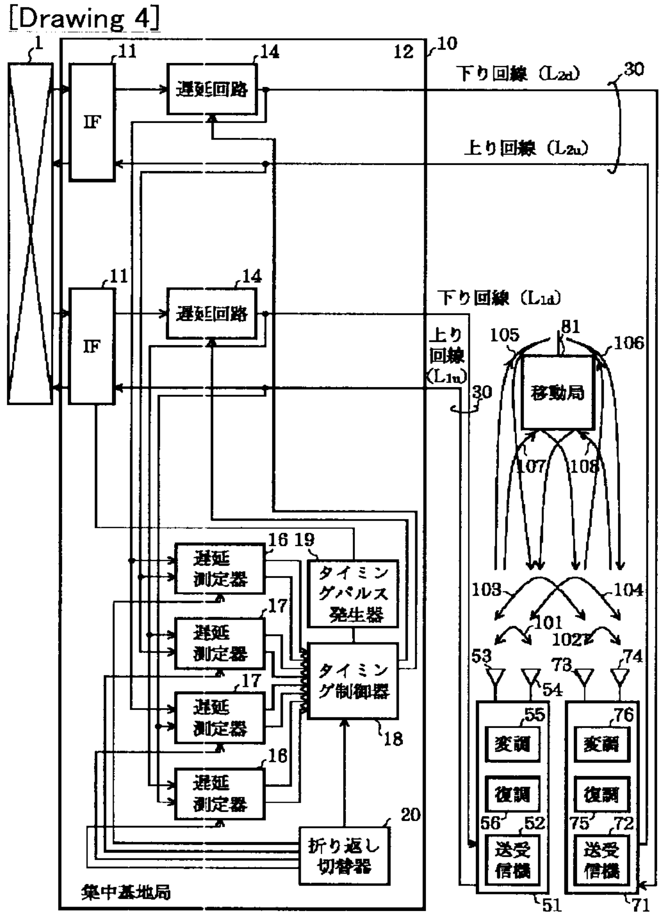
[Drawing 2]



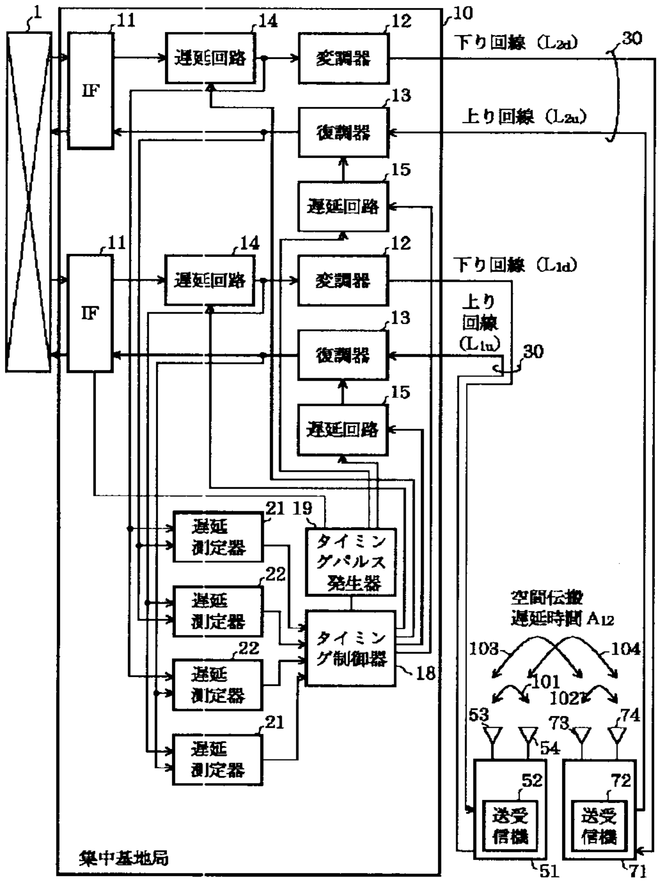
[Drawing 3]



[Drawing 4]



[Drawing 5]



[Translation done.]

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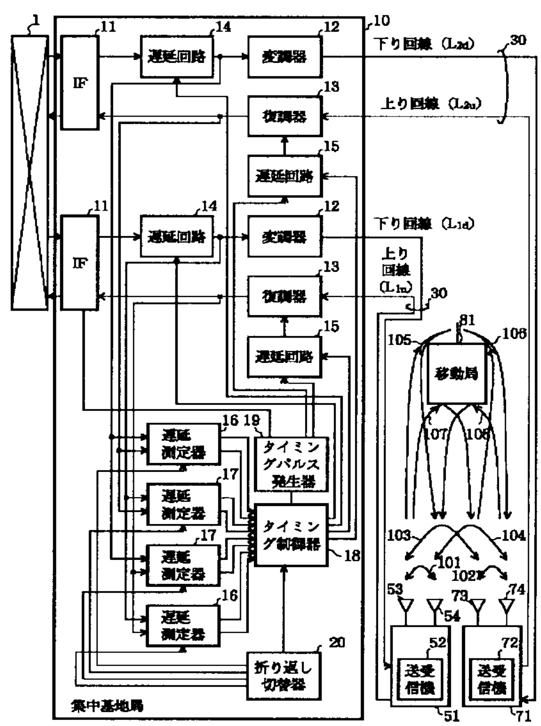
(54)【発明の名称】　移動通信装置

(57)【要約】
【課題】　通信する無線基地局が異なる場合でも移動局においてビット同期を確立できるようにする。
【解決手段】　集中基地局から送出した信号が無線基地局から送信されてその同じ無線基地局に受信されて集中基地局に戻るまでの伝達時間と、同じく他の無線基地局に受信されて集中基地局に戻るまでの伝達時間と、集中基地局から送出した信号が無線基地局から送信されて移動局により受信され、その移動局が送信した信号が同じ無線基地局に受信されて集中基地局に戻るまでの伝達時間と、同じく移動局が送信した信号が他の無線基地局に受信されて集中基地局に戻るまでの伝達時間とをそれぞれ測定し、その測定結果により集中基地局から無線基地局に送信するタイミングを調整する。



【特許請求の範囲】

【請求項１】　移動局との間で無線により通信を行う複数の無線基地局と、この複数の無線基地局への送信信号の分配およびこの複数の無線基地局がそれぞれ受信した信号の収集を行う集中基地局とを備え、
前記集中基地局は、前記複数の無線基地局のそれぞれとの間の伝送路遅延を測定する遅延測定手段と、この遅延測定手段の測定値にしたがって前記複数の無線基地局にそれぞれ送出する信号のタイミングを調整するタイミング調整手段とを含み、
前記遅延測定手段は、前記複数の無線基地局のそれぞれに対し、
前記集中基地局から送出した信号がその無線基地局から送信され直接に同じ無線基地局により受信されて前記集中基地局に戻るまでの伝達時間を測定する第一の測定手段と、
前記集中基地局から送出した信号がその無線基地局から送信され他の無線基地局により受信されて前記集中基地局に戻るまでの伝達時間を測定する第二の測定手段とを含む移動通信装置において、
前記遅延測定手段はさらに、前記複数の無線基地局のそれぞれに対し、
前記集中基地局から送出した信号がその無線基地局から送信されて移動局により受信され、その移動局が送信した信号が同じ無線基地局により受信されて前記集中基地局に戻るまでの伝達時間を測定する第三の測定手段と、
前記集中基地局から送出した信号がその無線基地局から送信されて移動局により受信され、その移動局が送信した信号が他の無線基地局により受信されて前記集中基地局に戻るまでの伝達時間を測定する第四の測定手段とを含むことを特徴とする移動通信装置。

【請求項２】　前記第一の測定手段と前記第三の測定手段とは共通の遅延測定器により構成され、この共通の遅延測定器の動作を切り替える手段を備えた請求項１記載の移動通信装置。

【請求項３】　前記第二の測定手段と前記第四の測定手段とは共通の遅延測定器により構成され、この共通の遅延測定器の動作を切り替える手段を備えた請求項１または２記載の移動通信装置。

【請求項４】　前記タイミング調整手段は、二以上の移動局に実質的に同じタイミングでデータが到達するようにタイミングを調整する手段を含む請求項１記載の移動通信装置。

【請求項５】　前記タイミング調整手段は、二以上の無線基地局からひとつの移動局に送信するデータをその移動局でビット同期させる手段を含む請求項１記載の移動通信装置。

【請求項６】　前記複数の無線基地局が送信する信号をそれぞれ変調する複数の変調器および前記複数の無線基地局が受信した信号をそれぞれ復調する複数の復調器が前記集中基地局に設けられ、
前記集中基地局には、前記復調器の動作タイミングを前記遅延測定手段の測定値にしたがって調整する手段を含む請求項１記載の移動通信装置。

【請求項７】　移動局へ送信する信号の変調を行う変調器および移動局から受信した信号を復調する復調器が前記複数の無線基地局のそれぞれに設けられた請求項１記載の移動通信装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明はＴＤＭＡ－ＴＤＤ (Time Division Multiple Access-Time DivisionDuplex) 方式を用いた移動通信装置に関する。特に、バースト変復調を行う場合の送受間の遅延調整、および移動局が通信する無線基地局が異なる場合であっても移動局が受信するバーストのフレームのタイミング同期を行う技術に関する。

【０００２】

【従来の技術】ＴＤＭＡ－ＴＤＤ方式では、バースト変調信号により同一無線キャリアを使用して時分割で双方向の通信を行う。無線基地局を集中制御する方法を採用した場合、集中基地局においてバースト変調したバースト変調信号は、伝送路を経由して無線基地局に伝送され、無線基地局のアンテナから送信されて移動局で受信される。移動局の送信したバースト変調信号は、無線基地局のアンテナで受信され、伝送路を経由して集中基地局の復調器に入力され、受信データに復調される。バースト変復調では、受信されたデータの中からユニークワードパターンを検出することにより、変調バースト位置を検出する。受信データとユニークワードパターンを常時一致比較検出すると、真のユニークワード以外にもユニークワードと同一の受信パターンが存在する場合があり、タイミング位置を正しく判定できないおそれがあるため、ユニークワード検出窓を設置して検出窓でのみ一致比較検出を行い、誤検出率を改善する必要がある。この検出窓の送信バーストからの遅延量は送受間のタイミングにより設定する。伝送路を用いた集中制御では、ユニークワード検出窓の位置をタイミング制御器により制御しなければならない。送信バーストのユニークワードの位置と受信バーストのユニークワードの位置とを比較することで、伝送路伝達の所要時間を測定できる。

【０００３】また、ＴＤＭＡ－ＴＤＤ方式では、複数の無線基地局間で送信するバーストのタイミング同期をとって、フレーム同期で送信バースト位相を揃える。伝送路遅延のために遅れたタイミングで無線基地局から送信すると、移動局のユニークワード検出窓の位置に無線基地局からのユニークワードが当てはまらない。そのため、バースト変調データを復調することができず、同期がとれない。これを避けるため、集中基地局では、伝送路遅延時間を見込んで、無線基地局から送信するバース

ト位置よりも下り伝送路遅延時間だけ事前に送信する必要があり、上り伝送路遅延時間だけ遅らせて受信する必要がある。

【０００４】図５は従来例の移動通信装置を示すブロック構成図である。この移動通信装置は、公衆網１に接続され変復調器が集中配置された集中基地局１０と、この集中基地局１０に伝送路３０を介して接続されアンテナから電波を送受信することにより移動局との間で通信を行う無線基地局５１、７１とを備える。集中基地局１０は、公衆網１との間の信号変換を行うインターフェース回路１１と、無線基地局５１、７１に送信するデータを変調する変調器１２と、無線基地局５１、７１からのデータを復調する復調器１３と、送信データの遅延量を可変に設定する遅延回路１４と、受信データの遅延量を可変に設定する遅延回路１５と、集中基地局１０から送信されたデータと集中基地局１０で受信されたデータとを比較して伝送路通過の所要時間を測定する遅延測定器２１、２２と、この遅延測定器２１、２２の測定値により送受信のタイミング調整量を算出するタイミング制御器１８と、タイミング調整を行うための基準タイミングを発生するタイミング発生器１９とを備える。無線基地局５１は、無線信号を無線周波数に変換して送信および受信する送受信機５２と、二つのアンテナ５３、５４とを備え、送信は一方のアンテナ５３または５４で行い、受信は両方のアンテナ５３、５４で行って受信レベルの高い方が選択されるものとする。無線基地局７１も同様に、送受信機７２と二つのアンテナ７３、７４とを備える。

【０００５】集中基地局１０から送信したデータが集中基地局１０に戻る経路としては、伝送路３０に加え、下り回線からの信号を無線基地局５１、７１のそれぞれの一方のアンテナ５３または５４、７３または７４から無線区間に送信して同一の無線基地局５１、７１のそれぞれの他方のアンテナ５４または５３、７４または７３で受信される空間伝搬経路１０１、１０２と、下り回線からの信号を無線基地局５１、７１のそれぞれのアンテナ５３または５４、７３または７４から無線区間に送信して別の無線基地局７１、５１のそれぞれのアンテナ７３あるいは７４、５３あるいは５４で受信される空間伝搬経路１０３、１０４とがある。通常、アンテナ間距離は無線基地局間距離に比べて非常に短いため、空間伝搬経路１０１、１０２による伝搬遅延時間は考慮する必要はない。以下では、空間伝搬経路１０３、１０４による空間伝搬遅延時間をA_{12}とする。

【０００６】遅延測定器２１は、集中基地局１０からデータを送信したタイミングと、無線基地局５１、７１から信号を送信してこれを同一の無線基地局５１、７１を経由して集中基地局１０で受信したタイミングとを比較して、空間伝搬経路１０１、１０２をそれぞれ経由したときの伝送路の往復の所要時間を測定する。一方、遅延測定器２２は、集中基地局１０からデータを送信したタイミングと、無線基地局５１、７１から信号を送信してこれを異なる無線基地局７１、５１を経由して集中基地局１０で受信したタイミングとを比較して、空間伝搬経路１０３、１０４をそれぞれ経由したときの伝送路の往復所要時間を測定する。タイミング制御器１８は、遅延測定器２１、２２の測定値に基づいて、下り回線の送信タイミングと上り回線の受信タイミングとを計算し、遅延回路１４、１５により送受信タイミングを調整する。これにより、集中基地局１０と複数の無線基地局５１、７１との間の伝送路３０において、上下回線ともに無線基地局５１、７１ごとに伝送路時間差がある場合に、無線基地局５１、７１間においてビット同期を確立することができる。

【０００７】

【発明が解決しようとする課題】しかし、従来の移動通信装置では、ある無線基地局と移動局との間の空間伝搬遅延時間と、他の無線基地局と移動局との間の空間伝搬遅延時間とが異なる場合には、通信している複数の無線基地局に対して移動局間でのフレーム同期位相を合わせることはできず、移動局や無線基地局におけるフレーム毎のデータのジッタの許容範囲が小さい場合には、接続している無線基地局を他の無線基地局へ無瞬断で切り替える無瞬断ハンドオーバを実現できない。さらに、複数の無線基地局で受信したデータを伝送路により集中基地局に伝送してそれらのデータを判定することにより基地局を切り替えて送信する送信セル間ダイバーシチも実現できない。

【０００８】一般に、移動局は任意の位置から通信を行うため、空間伝搬遅延時間は特定できず、ある無線基地局と移動局との間の伝搬時間A_1と、他の無線基地局と移動局との間の伝搬時間A_2とは等しくない。さらに、移動局が通信中に移動することにより、伝搬時間A_1、A_2は時々刻々と変化する。このため、移動局において複数の無線基地局から送信されるデータのビット同期がとれず、離れた２局の無線基地局に送信データを切り替えて移動局に送信する送信セル間ダイバーシチ切り替えができなかった。

【０００９】本発明は、このような課題を解決し、集中基地局と複数の移動局間の通信において、伝送路および伝搬路遅延時間がランダムである場合に、通信する無線基地局が異なる移動局間においてビットの同期を確立することのできる移動通信装置を提供することを目的とする。

【００１０】

【課題を解決するための手段】本発明の移動通信装置は、移動局との間で無線により通信を行う複数の無線基地局と、この複数の無線基地局への送信信号の分配およびこの複数の無線基地局がそれぞれ受信した信号の収集を行う集中基地局とを備え、集中基地局は、各無線基地

局との間の伝送路遅延を測定する遅延測定手段と、この遅延測定手段の測定値にしたがって各無線基地局に送出する信号のタイミングを調整するタイミング調整手段とを含み、遅延測定手段は、各無線基地局に対し、集中基地局から送出した信号がその無線基地局から送信され直接に同じ無線基地局により受信されて集中基地局に戻るまでの伝達時間を測定する第一の測定手段と、集中基地局から送出した信号がその無線基地局から送信され他の無線基地局により受信されて集中基地局に戻るまでの伝達時間を測定する第二の測定手段とを含む移動通信装置において、遅延測定手段はさらに、各無線基地局に対し、集中基地局から送出した信号がその無線基地局から送信されて移動局により受信され、その移動局が送信した信号が同じ無線基地局により受信されて集中基地局に戻るまでの伝達時間を測定する第三の測定手段と、集中基地局から送出した信号がその無線基地局から送信されて移動局により受信され、その移動局が送信した信号が他の無線基地局により受信されて集中基地局に戻るまでの伝達時間を測定する第四の測定手段とを含むことを特徴とする。

【００１１】すなわち本発明では、

① 移動局を介さずに無線基地局でデータを折り返してその送信データと受信データとを比較して伝送路の送受信間の遅延時間を測定し、

② 移動局を介さずに無線基地局の送信データを他の無線基地局で受信して伝送路を通じて集中基地局で復調した受信データと比較して遅延時間を測定し、

③ 移動局との通信時に無線基地局の送信データと受信データとを比較して伝送路の送受信間の遅延時間を測定し、

④ 移動局との通信時に無線基地局の送信データを他の無線基地局で受信して伝送路を通じて集中基地局で復調した受信データと比較して遅延時間を測定する。そして、これらの測定値により、下り回線の伝送路遅延時間と空間伝搬時間との両者を含めた分の送信タイミング変化時間と、上り回線の伝送路遅延時間と空間伝搬時間との両者を含めた分の受信タイミング変化時間とを計算により求め、この計算結果にしたがって送信タイミングおよび受信タイミングを調整する。これにより、通信している無線基地局が異なる複数の移動局間での同期を確立し、集中基地局での受信を可能にする。以下では、①、②のように移動局を介することなくデータを受信して集中基地局に伝送することを「折り返し」という。

【００１２】第一の測定手段と第三の測定手段とは共通の遅延測定器により構成され、この共通の遅延測定器の動作を切り替える手段を備えることができる。第二の測定手段と第四の測定手段についても同様に、共通の遅延測定器により構成され、この共通の遅延測定器の動作を切り替える手段を備えることができる。

【００１３】タイミング調整手段は、二以上の移動局に実質的に同じタイミングでデータが到達するようにタイミングを調整する手段、あるいは二以上の無線基地局からひとつの移動局に送信するデータをその移動局でビット同期させる手段を含むことができる。

【００１４】各無線基地局が送信する信号をそれぞれ変調する複数の変調器および各無線基地局が受信した信号をそれぞれ復調する複数の復調器を集中基地局に設け、この集中基地局には、復調器の動作タイミングを遅延測定手段の測定値にしたがって調整する手段を備えることができる。また、変調器および復調器が無線基地局のそれぞれに設けてもよい。

【００１５】本発明によれば、空間伝搬遅延時間を含めた遅延時間測定が可能となり、移動局は、通信可能な任意の位置において、異なる無線基地局との通信をしている移動局間でのビット同期を確立できる。すなわち、移動局は、自局の通信している無線基地局以外の無線基地局の間においても、移動局が受信するバーストのタイミングの同期をとることができる。このため、移動局が通話中の状態において、移動局および無線基地局が受信するフレーム毎のデータの許容ジッタが伝送路遅延時間や伝搬遅延時間と比べて極めて小さい場合であっても、無線基地局と移動局との間の空間伝搬時間によらず、接続している無線基地局を他の無線基地局へ無瞬断で切り替える無瞬断ハンドオーバを実現できる。さらに、複数の無線基地局で受信したデータを伝送路により集中基地局に伝送して判定することにより、無線基地局を切り替えて送信する送信セル間ダイバーシチが可能になる。

【００１６】

【発明の実施の形態】図１は本発明の第一の実施形態を示すブロック構成図である。この移動通信装置は、移動局８１（ここでは一つのみ示す）との間で無線により通信を行う複数の無線基地局５１、７１と、この複数の無線基地局５１、７１への送信信号の分配およびこの複数の無線基地局５１、７１がそれぞれ受信した信号の収集を行う集中基地局１０とを備える。集中基地局１０は、変調器１２および復調器１３と公衆網１との間の伝送信号変換を行うインターフェイス回路１１と、無線基地局５１、７１に送信するデータを変調する変調器１２と、無線基地局５１、７１からのデータを復調する復調器１３と、送信データの遅延量を可変に設定する遅延回路１４と、受信データの遅延量を可変に設定する遅延回路１５と、無線基地局５１、７１のそれぞれとの間の伝送路遅延を測定する遅延測定器１６、１７および折り返し切替器２０と、遅延測定器１６、１７の測定値にしたがって無線基地局５１、７１にそれぞれ送出する信号のタイミングを調整するタイミング制御器１８と、タイミング制御器１８を制御するために必要な基準タイミングを生成するタイミングパルス発生器１９とを備える。無線基地局５１は、無線信号を無線周波数に変換して送信および受信する送受信機５２と、二つのアンテナ５３、５４

とを備え、送信は一方のアンテナ５３で行い、受信は両方のアンテナ５３、５４で行ってその受信波のうち受信レベルの高い方を選択する構成となっている。無線基地局７１も同様に、送受信機７２とアンテナ７３、７４とを備える。

【００１７】遅延測定器１６、１７は、折り返し切替器２０の制御により、無線基地局５１、７１が移動局８１と通信を行うときと行っていないときとで、異なる遅延時間を測定する。

【００１８】すなわち、遅延測定器１６は、移動局８１と通信を行わないとき、集中基地局１０から無線基地局５１、７１へ信号を送出したタイミングと、集中基地局１０から無線基地局５１、７１へ信号を送出して、無線基地局５１、７１のアンテナ５３、７３により送信され、その局の他方のアンテナ５４、７４により受信された信号を無線基地局５１、７１から集中基地局１０へ伝送して、集中基地局１０において信号を受信したタイミングとを比較することにより、伝送路通過に要する所要時間を測定する。遅延測定器１６はまた、移動局８１と通信を行うとき、集中基地局１０から無線基地局５１、７１へ送出したタイミングと、集中基地局１０から無線基地局５１、７１へ信号を送出して、無線基地局５１、７１から移動局８１へ送信され、応答した移動局８１からの信号を無線基地局５１、７１が受信して、無線基地局５１、７１から集中基地局１０まで伝送され、集中基地局１０で信号を受信したタイミングとを比較することにより、移動局８１との通信時に伝送路通過に要する所要時間を測定する。

【００１９】一方、遅延測定器１７は、移動局８１と通信を行わないとき、集中基地局１０から無線基地局５１、７１へ信号を送出したタイミングと、集中基地局１０から無線基地局５１、７１へ信号を送出して、無線基地局５１、７１のアンテナ５３、７３により送信され、他の無線基地局７１、５１のアンテナ７３または７４、５３または５４により受信された信号をその無線基地局７１、５１から集中基地局１０へ伝送して、集中基地局１０において信号を受信したタイミングとを比較することにより、伝送路通過に要する所要時間を測定する。遅延測定器１７はまた、移動局８１と通信を行うとき、集中基地局１０から無線基地局５１、７１へ送出したタイミングと、集中基地局１０から無線基地局５１、７１へ信号を送出して、無線基地局５１、７１から移動局８１へ送信され、応答した移動局８１からの信号を他の無線基地局７１、５１が受信して、その無線基地局７１、５１から集中基地局１０まで伝送され、集中基地局１０で信号を受信したタイミングとを比較することにより、移動局８１との通信時に伝送路通過に要する所要時間を測定する。

【００２０】遅延測定器１６および１７のそれぞれの測定結果は、タイミング制御器１８に入力される。タイミング制御器１８は、これらの測定結果から、送受信のタイミング調整量を算出し、遅延回路１４および１５の遅延量を設定する。遅延回路１４は、タイミング制御器１８からの情報により、無線基地局５１、７１から送信するデータの遅延量を可変に設定する。遅延回路１５は、タイミング制御器１８からの情報により、無線基地局５１、７１におけるデータを受信できるタイミングを可変に設定する。タイミング制御器１８を制御するために必要な基準タイミングは、タイミングパルス発生器１９により生成される。遅延測定器１６、１７の動作は、折り返し切替器２０により切り替えられる。

【００２１】伝送路遅延時間および空間伝搬遅延時間の測定について、さらに詳しく説明する。ここで、集中基地局１０と無線基地局５１との間の伝送路３０における下り回線の伝送路伝達時間をL_{1d}、上り回線の伝送路伝達時間をL_{1u}とする。また、集中基地局１０と無線基地局７１との間の伝送路３０における下り回線の伝送路伝達時間をL_{2d}、上り回線の伝送路伝達時間をL_{2u}とする。

【００２２】まず、移動局と通話を行わないときの伝送路遅延時間の測定および空間伝搬遅延時間の測定について説明する。

【００２３】この場合、集中基地局１０の変調器１２により変調した信号を伝達時間L_{1d}の下り回線を介して無線基地局５１に伝送し、無線基地局５１において無線周波数に変換し、無線基地局５１のアンテナ５３から送信し、無線基地局５１のアンテナ５４で受信し、サブキャリア周波数に変換して、伝達時間L_{1u}の上り回線を介して集中基地局１０に伝送し、復調器１３により復調する。このとき、集中基地局１０にてユニークワードを検出することで、変調後に送信してから受信して復調するまでの時間を遅延時間として測定する。これにより$L_{1d}+L_{1u}$の伝達時間が測定される。この時間をT_{11}とする。無線基地局７１についても同様に測定を行い、$L_{2d}+L_{2u}$の伝達時間が測定される。この時間をT_{22}とする。

【００２４】また、集中基地局１０の変調器１２により変調した信号を伝達時間L_{1d}の下り回線を介して無線基地局５１に伝送し、無線基地局５１において無線周波数に変換し、無線基地局５１のアンテナ５３から送信し、空間伝搬時間A_{12}の伝搬路を介して無線基地局７１のアンテナ７３または７４で受信し、伝達時間L_{2u}の上り回線を介して集中基地局１０に伝送して復調器１３により復調する。このとき、集中基地局１０にて送受信前後にユニークワードを検出することで、変調後に送信してから受信して復調するまでの時間を遅延時間として測定する。これにより$L_{1d}+A_{12}+L_{2u}$の伝達時間が測定される。この時間をT_{12}とする。無線基地局７１から送信して無線基地局５１が受信する場合についても同様に測定を行い、$L_{2d}+A_{12}+L_{1u}$の伝達時間が測定される。こ

の時間をT_{21}とする。

【００２５】これらの測定結果から伝送路遅延時間差を求める。上記の条件を式で示すと、

$L_{1d}+L_{1u}=T_{11}$　…（１）

$L_{2d}+L_{2u}=T_{22}$　…（２）

$L_{1d}+L_{2u}+A_{12}=T_{12}$　…（３）

$L_{2d}+L_{1u}+A_{12}=T_{21}$　…（４）

となる。（３）＋（４）−（１）−（２）より、

$2A_{12}=T_{12}+T_{21}-T_{11}-T_{22}$　…（５）

$A_{12}=(T_{12}+T_{21}-T_{11}-T_{22})/2$　…（６）

となる。また、（１）−（３）より、

$T_{11}-T_{12}=(L_{1u}-L_{2u})-A_{12}$　…（７）

$L_{1u}-L_{2u}=T_{11}-T_{12}+A_{12}$　…（８）

（２）−（４）より、

$T_{11}-T_{21}=(L_{1d}-L_{2d})-A_{12}$　…（９）

$L_{1d}-L_{2d}=T_{11}-T_{12}+A_{12}$　…（１０）

となる。（８）式より、無線基地局５１から集中基地局１０までの上り回線と無線基地局７１から集中基地局までの上り回線との伝達時間差$L_{1u}-L_{2u}$が求められる。また、（１０）式により集中基地局１０から無線基地局５１への下り回線と集中基地局１０から無線基地局７１までの下り回線との伝達時間差$L_{1d}-L_{2d}$が求められる。

【００２６】次に、移動局８１と通話を行うときの伝送路遅延時間の測定および空間伝搬遅延時間の測定について説明する。ここで、移動局８１は始めに無線基地局５１を介して通信を行っているものとする。

【００２７】集中基地局１０の変調器１２により変調した信号を伝達時間L_{1d}の下り回線を介して無線基地局５１に伝送し、無線基地局５１において無線周波数に変換し、無線基地局５１のアンテナ５３から送信し、空間伝搬時間A_1の伝搬路を介して移動局８１のアンテナで受＊＊信され、これに応答した移動局８１からのデータを移動局８１のアンテナから送信し、空間伝搬時間A_1の伝搬路を介して無線基地局５１のアンテナ５３、５４で受信し、伝達時間L_{1u}の上り回線を介して集中基地局１０に伝送し、復調器１３により復調する。このとき、集中基地局１０にてユニークワードを検出することで、変調後に送信してから受信して復調するまでの時間を遅延時間として測定する。これにより$L_{1d}+A_1+A_1+L_{1u}$の伝達時間が測定される。この時間をT_{1a1}とする。

【００２８】また、集中基地局１０の変調器１２により変調した信号を伝達時間L_{1d}の下り回線を介して無線基地局５１に伝送し、無線基地局５１において無線周波数に変換し、無線基地局５１のアンテナ５３から送信し、空間伝搬時間A_1の伝搬路を介して移動局８１のアンテナで受信され、これに応答した移動局８１からのデータを移動局８１のアンテナから送信し、空間伝搬時間A_2の伝搬路を介して無線基地局７１のアンテナ７３、７４で受信し、無線基地局７１でサブキャリア周波数に変換して、伝達時間L_{2u}の上り回線を介して集中基地局１０に伝送し、復調器１３により復調する。このとき、集中基地局１０にてユニークワードを検出することで、変調後に送信してから受信して復調するまでの時間を遅延時間として測定する。これにより$L_{1d}+A_1+A_2+L_{2u}$の伝達時間が測定される。この時間をT_{1a2}とする。

【００２９】これらの測定結果から伝送路遅延時間差を求める。上記の条件を式で示すと、

$L_{1d}+A_1+A_1+L_{1u}=T_{1a1}$　…（１１）

$L_{1d}+A_1+A_2+L_{2u}=T_{1a2}$　…（１２）

となる。次に、必要とされている送信タイミング変化時間をｄｅｌａｙ１、受信タイミング変化時間をｄｅｌａｙ２とすると、

$$\mathrm{delay1}=(L_{1d}+A_1)-(L_{2d}+A_2)\quad\cdots(13)$$

$$\mathrm{delay2}=(L_{1u}+A_1)-(L_{2u}+A_2)\quad\cdots(14)$$

と表される。（１１）−（１２）より、

$$(L_{1u}+A_1)-(L_{2u}+A_2)=T_{1a1}-T_{1a2}\quad\cdots(15)$$

となり、したがって、

$$\mathrm{delay2}=T_{1a1}-T_{1a2}\quad\cdots(16)$$

としてｄｅｌａｙ２を導くことができる。また、（１　※　※５）式を変形して、

$$(L_{1u}-L_{2u})+(A_1-A_2)=T_{1a1}-T_{1a2}\quad\cdots(17)$$

とする。（１７）−（１８）より、

$$(T_{11}-T_{12}+A_{12})+(A_1-A_2)=T_{1a1}-T_{1a2}\quad\cdots(18)$$

であるから、

$$(A_1-A_2)=(T_{1a1}-T_{1a2})-(T_{11}-T_{12}+A_{12})\cdots(19)$$

となる。また、（１３）式を変形して、

$$\mathrm{delay1}=(L_{1d}-L_{2d})-(A_1-A_2)\quad\cdots(20)$$

であるから、（１９）、（２０）および（１０）式よ　★　★り、

$$\mathrm{delay1}=(T_{11}-T_{12}+A_{12})-(T_{11}-T_{12}+A_{12})+(T_{1a1}-T_{1a2})\quad\cdots(21)$$

が得られる。（１６）式より、移動局８１から無線基地局５１を通して集中基地局１０までの上り回線と無線基

地局７１を通して集中基地局までの上り回線との伝達時間差（L_{1u} ＋A_1 ）－（L_{2u} ＋A_2 ）が求められる。また、（２１）式により、集中基地局１０から無線基地局５１を通して移動局８１への下り回線と集中基地局１０から無線基地局７１を通して移動局８１までの下り回線との伝達時間差（L_{1d} ＋A_1 ）－（L_{2d} ＋A_2 ）が求められる。

【００３０】このようにして求められた伝達時間差を用いて、異なる無線基地局と通信を行っている移動局のビット同期を実現できる。

【００３１】図２は同期をとるためのタイミング調整を説明する図であり、図３は信号伝達のタイミングを説明する図である。ここでは、L_{1d} －L_{2d} ＞０、L_{1u} －L_{2u} ＞０、（L_{1d} ＋A_1 ）－（L_{2d} ＋A_2 ）＞０、（L_{1u} ＋A_1 ）－（L_{2u} ＋A_2 ）＞０と仮定する。移動局における送受信の基準タイミングの間隔はＴｄとする。また、無線基地局を「１」、「２」で表し、移動局はこれらの無線基地局「１」、「２」のうち最初に無線基地局「２」を介して通信を行うものとする。

【００３２】まず、集中基地局から無線基地局「２」に信号を送出し、無線基地局「２」から無線区間に信号を送出して、その信号がそのまま無線基地局「１」、「２」により受信された集中基地局まで戻る時間をそれぞれ測定する。次に、集中基地局から無線基地局「２」に信号を送出し、無線基地局「２」から無線区間に信号を送出して移動局が受信し、移動局がこれに対して応答して送信した信号が、無線基地局「１」、「２」によりそれぞれ受信されて集中基地局まで戻る時間をそれぞれ測定する。これにより集中基地局では、下り送信タイミングとして、無線基地局「２」へ送信するタイミングよりｄｅｌａｙ１の時間だけ早めて無線基地局「１」へ信号を送信する必要があることがわかる。また、上り受信タイミングとして、無線基地局「２」より送られてくるタイミングよりｄｅｌａｙ２の時間だけ遅れて無線基地局「１」から信号が到着することがわかる。

【００３３】したがって、これ以降、集中基地局は、無線基地局「２」へ送信するタイミングよりｄｅｌａｙ１だけ早めて無線基地局「１」へ信号を送信する。これにより移動局では、無線基地局「１」から送信された信号と無線基地局「２」から送信された信号との時間的な差異がなくなり、通信相手の無線基地局を「２」から「１」に切り替えて通信を継続することができる。集中基地局はまた、無線基地局「２」より送られてくる信号の受信タイミングを無線基地局「１」から送られてくる信号の受信タイミングに対してｄｅｌａｙ２だけ遅らせることで、二つの無線基地局「１」、「２」からの信号の受信タイミングを合わせて受信することができる。

【００３４】ここではL_{1d} －L_{2d} 、L_{1u} －L_{2u} 、（L_{1d} ＋A_1 ）－（L_{2d} ＋A_2 ）および（L_{1u} ＋A_1 ）－（L_{2u} ＋A_2 ）がすべて正の場合を例に説明したが、これらの値は負または零でも同様である。

【００３５】このように、空間伝搬遅延時間を含めた下り回線の伝搬時間差分だけ送信タイミングを調整することにより、複数の無線基地局からの信号について移動局でのビット同期が可能になる。また、空間伝搬遅延時間を含めた上り回線の伝達遅延時間差分だけ受信タイミングを調整することで、集中基地局においてバーストが重なることなく受信が可能になる。

【００３６】図４は本発明の第二の実施形態を示すブロック構成図である。この移動通信装置は、移動局へ送信する信号の変調を行う変調器および移動局から受信した信号を復調する復調器が各無線基地局に設けられたことが第一の実施形態と異なる。すなわち、移動局８１（ここでは一つのみ示す）との間で無線により通信を行う複数の無線基地局５１、７１と、この複数の無線基地局５１、７１への送信信号の分配およびこの複数の無線基地局５１、７１がそれぞれ受信した信号の収集を行う集中基地局１０とを備え、集中基地局１０は、公衆網１との間の伝送信号変換を行うインターフェース回路１１と、送信データの遅延量を可変に設定する遅延回路１４と、無線基地局５１、７１のそれぞれとの間の伝送路遅延を測定する遅延測定器１６、１７および折り返し切替器２０と、遅延測定器１６、１７の測定値にしたがって無線基地局５１、７１にそれぞれ送出する信号のタイミングを調整するタイミング制御器１８およびタイミングパルス発生器１９とを備える。無線基地局５１は、無線信号を無線周波数に変換して送信および受信する送受信機５２と、集中基地局１０からのデータを変調する変調器５５と、無線により受信した信号を復調する復調器５６と、二つのアンテナ５３、５４とを備え、送信は一方のアンテナ５３で行い、受信は両方のアンテナ５３、５４で行ってその受信波のうち受信レベルの高い方を選択する構成となっている。無線基地局７１も同様に、送受信機７２、アンテナ７３、７４、復調器７５および変調器７６を備える。

【００３７】遅延測定器１６は、移動局８１と通信を行わないとき、集中基地局１０から無線基地局５１、７１へ信号を送出したタイミングと、集中基地局１０から無線基地局５１、７１へ信号を送出して、無線基地局５１、７１の変調器５５、７６により変調されてアンテナ５３、７３により送信され、その局の他方のアンテナ５４、７４により受信され復調器５６、７５により復調された信号を無線基地局５１、７１から集中基地局１０へ伝送して、集中基地局１０において信号を受信したタイミングとを比較することにより、伝送路通過に要する所要時間を測定する。遅延測定器１６はまた、移動局８１と通信を行うとき、集中基地局１０から無線基地局５１、７１へ送出したタイミングと、集中基地局１０から無線基地局５１、７１へ信号を送出して、無線基地局５１、７１から移動局８１へ送信され、応答した移動局８

１からの信号を無線基地局５１、７１が受信して、無線基地局５１、７１から集中基地局１０まで伝送され、集中基地局１０で信号を受信したタイミングとを比較することにより、移動局８１との通信時に伝送路通過に要する所要時間を測定する。

【００３８】一方、遅延測定器１７は、移動局８１と通信を行わないとき、集中基地局１０から無線基地局５１、７１へ信号を送出したタイミングと、集中基地局１０から無線基地局５１、７１へ信号を送出して、無線基地局５１、７１のアンテナ５３、７３により送信され、他の無線基地局７１、５１のアンテナ７３または７４、５３または５４により受信された信号をその無線基地局７１、５１から集中基地局１０へ伝送して、集中基地局１０において信号を受信したタイミングとを比較することにより、伝送路通過に要する所要時間を測定する。遅延測定器１７はまた、移動局８１と通信を行うとき、集中基地局１０から無線基地局５１、７１へ送出したタイミングと、集中基地局１０から無線基地局５１、７１へ信号を送出して、無線基地局５１、７１から移動局８１へ送信され、応答した移動局８１からの信号を他の無線基地局７１、５１が受信して、その無線基地局７１、５１から集中基地局１０まで伝送され、集中基地局１０で信号を受信したタイミングとを比較することにより、移動局８１との通信時に伝送路通過に要する所要時間を測定する。

【００３９】遅延測定器１６および１７のそれぞれの測定結果は、タイミング制御器１８に入力される。タイミング制御器１８は、これらの測定結果から、送受信のタイミング調整量を算出し、遅延回路１４の遅延量を設定する。遅延回路１４は、タイミング制御器１８からの情報により、無線基地局５１、７１から送信するデータの遅延量を可変に設定する。タイミング制御器１８を制御するために必要な基準タイミングは、タイミングパルス発生器１９により生成される。遅延測定器１６、１７の動作は、折り返し切替器２０により切り替えられる。

【００４０】この実施形態では、変調器へのデータ送信タイミングのみを考慮すればよく、復調器動作タイミングは変調器の動作タイミングより簡単に指定でき、伝送路遅延量を考慮しなくてよい。したがって、第一の実施形態で用いた遅延回路１５は不要である。伝送路遅延測定およびタイミング調整の方法は第一の実施形態と同様である。

【００４１】

【発明の効果】以上説明したように、本発明によれば、集中基地局と無線基地局との間の伝送路による伝達遅延時間が異なり無線基地局と移動局との間の空間伝搬距離が異なる場合であっても、移動局間の同期が可能となる。

【図面の簡単な説明】

【図１】本発明の第一の実施形態を示すブロック構成図。

【図２】同期をとるためのタイミング調整を説明する図。

【図３】信号伝達のタイミングを説明する図。

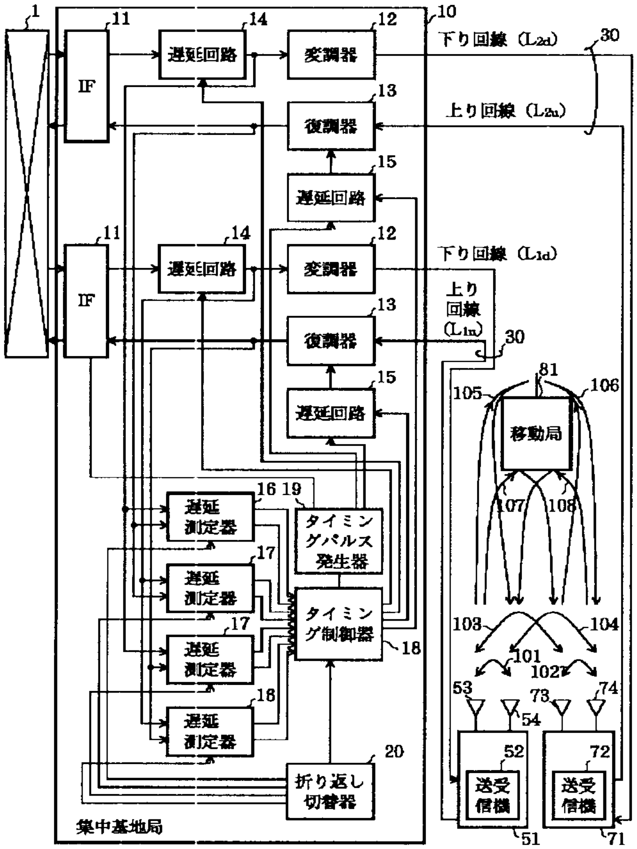
【図４】本発明の第二の実施形態を示すブロック構成図。

【図５】従来例の移動通信装置を示すブロック構成図。

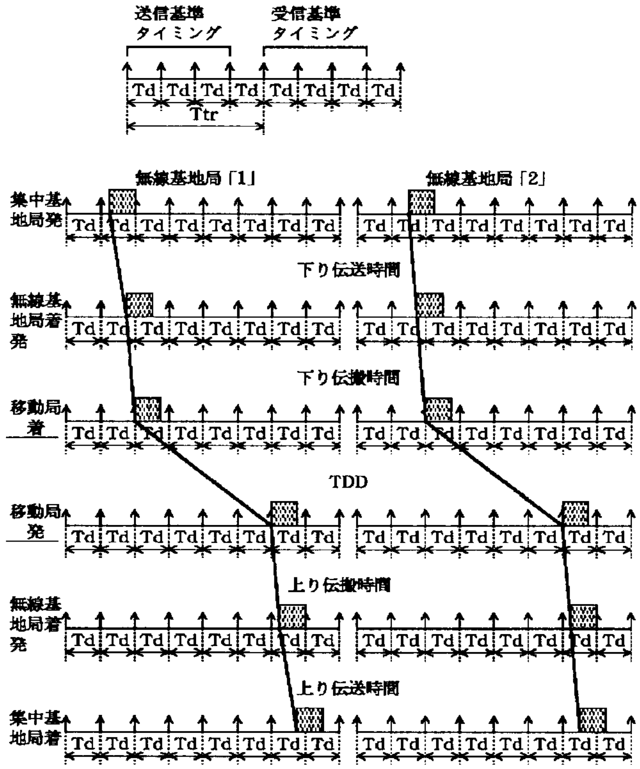
【符号の説明】

１　公衆網
１０　集中基地局
１１　インターフェース回路
１２、５５、７６　変調器
１３、５６、７５　復調器
１４、１５　遅延回路
１６、１７、２１、２２　遅延測定器
１８　タイミング制御器
１９　タイミングパルス発生器
２０　折り返し切替器
３０　伝送路
５１、７１　無線基地局
５２、７２　送受信機
５３、５４、７３、７４　アンテナ
８１　移動局

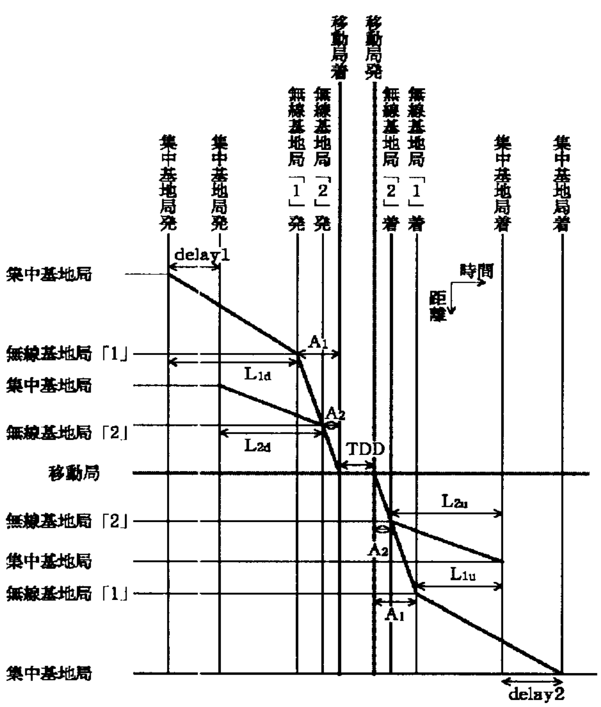
【図１】


IF
遅延回路
変調器
復調器
下り回線（L_{2d}）
上り回線（L_{2u}）
下り回線（L_{1d}）
上り回線（L_{1u}）
移動局
遅延測定器
タイミングパルス発生器
タイミング制御器
折り返し切替器
送受信機
集中基地局

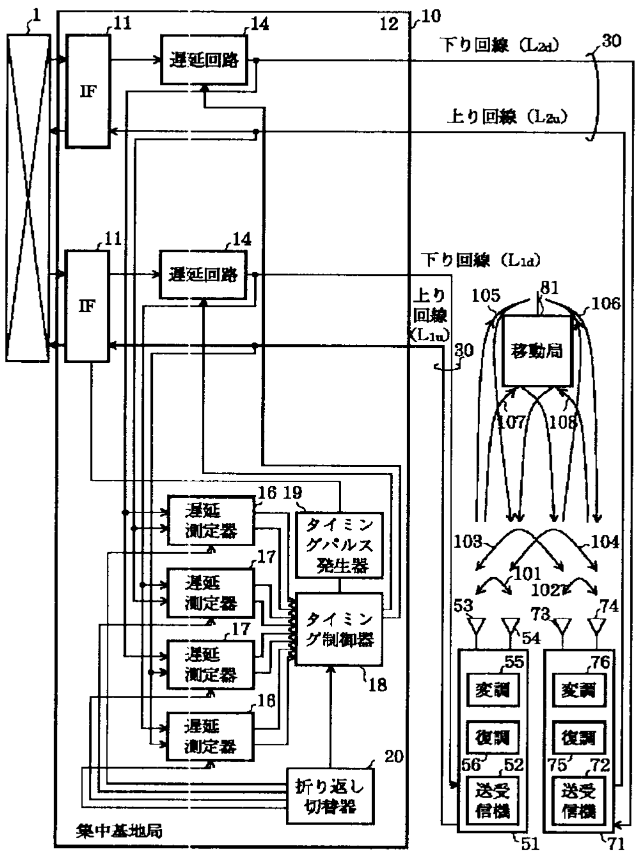
【図２】


送信基準タイミング
受信基準タイミング
Td
Ttr
無線基地局「1」
無線基地局「2」
集中基地局発
下り伝送時間
無線基地局着発
下り伝搬時間
移動局着
TDD
移動局発
上り伝搬時間
無線基地局着発
上り伝送時間
集中基地局着

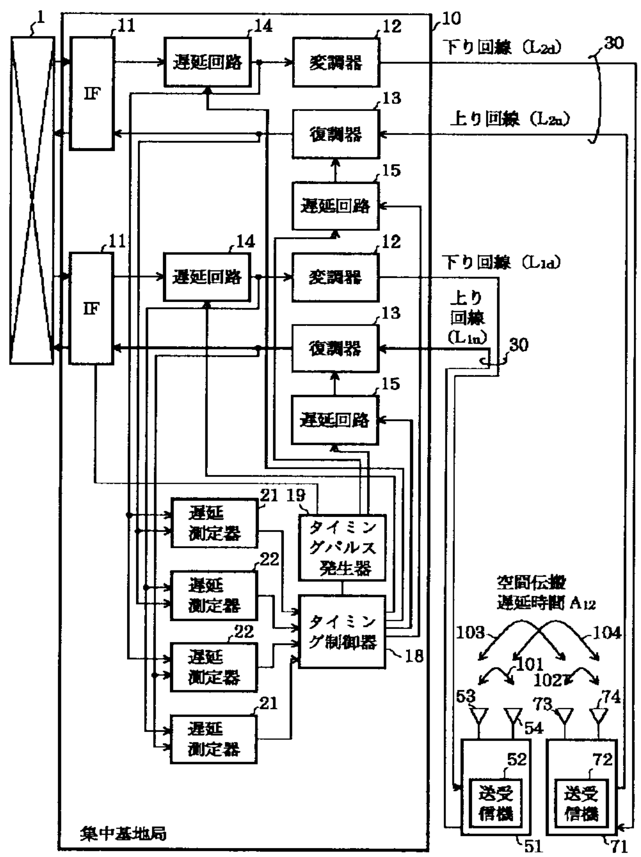
【図３】


集中基地局発
無線基地局「1」発
無線基地局「2」発
移動局着
移動局発
無線基地局「2」着
無線基地局「1」着
集中基地局着
delay1
delay2
時間
距離
集中基地局
無線基地局「1」
無線基地局「2」
移動局
L_{1d}
L_{2d}
L_{2u}
L_{1u}
A_1
A_2
TDD

【図４】


IF
遅延回路
下り回線（L2d）
上り回線（L2u）
下り回線（L1d）
上り回線（L1u）
移動局
遅延測定器
タイミングパルス発生器
タイミング制御器
折り返し切替器
変調
復調
送受信機
集中基地局

【図５】


IF
遅延回路
変調器
復調器
下り回線（L2d）
上り回線（L2u）
下り回線（L1d）
上り回線（L1u）
遅延測定器
タイミングパルス発生器
タイミング制御器
空間伝搬遅延時間A12
送受信機
集中基地局